MS-5000
Complete Control Cabinet for Milkcooling Tanks

Installation and operating instructions
for plant engineering companies

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Contents

Function

The MS-5000 is a complete control cabinet for milkcooling tanks. The integrated microprocessor regulator with automatic afterstirring has separate relay contacts for the compressor contactor and the stirrer. The measured milk temperature is shown constantly on the display, when the cooling mode is switched on.

Two freely adjustable target temperatures may be selected by push buttons. Should the milk temperature exceed the chosen target temperature (4° or 8°) by the hysteresis value, the compressor and stirrer are automatically switched on. Once the target temperature is reached, the compressor contactor switches off. The stirrer continues for the programmed period. During refrigeration pauses, the stirrer automatically switches on again according to the programmed intervals, to ensure an even temperature throughout the milk.

Independently of this, short or long "intermediate stirring" can be selected by pressing a button. Software can also be used to programme the MS-5000 for "permanent stirring", i.e. the agitator is switched on and off by pressing a button.

Cooling mode

Press the "4°/8°" button: the compressor and agitator operate automatically. In between cooling periods (agitator and compressor LEDs off), intermediate stirring can be activated.

Stirring mode

If stirring mode is active: (temperature shown in display)

- "Short" intermediate stirring:Briefly press the "Agitator" button."sho" appears in the display, and the agitator starts to operate.
- "Long" intermediate stirring:Press and hold down the "Agitator" button for 5 seconds."lon" appears in the display, and the agitator starts to operate.
- Continuous stirring (only if set at parameter level):Press the"Agitator" button. "On" appears in the display. The agitatoroperates continuously until the "Agitator" button is pressed again.

If OFF mode is active: (Display is dark)

- Continuous stirring while cooling is switched off:Press the "Agitator" button. A rotating bar is shown in the display, and the agitator operates continuously, until you press the button 'STOP'.

Off mode

The regulator can be switched off using the "STOP" button (Display and LEDs dark). Both the output relays for the agitator and compressor are deactivated.

> **CAUTION: The regulator is live even when switched off.**

4° / 8°

Switch between target temperatures (when cooling mode is active only)

Intended use

> **These operating instructions contain important technical and safety information. Please read carefully before installation and before any work on or with the regulator.**

The control cabinet for milk cooling tanks type MS-5000 is used to control the stirrer motors and cooling compressors of milk-cooling systems. Any other use of the device is permissible only with the manufacturer's written consent.

The control cabinet is ready for use once the parameters have been set. It should not be used before this has been done, as this might result in damage to the plant or the milk.

The device is fitted with a resistance temperature sensor. The output ports are designed as potential-free relay ports.

The device must not be installed in potentially explosive atmospheres.

$C\mkern-2mu\epsilon$ The control cabinet for milk cooling tanks type MS-5000 fulfils the EC requirements for electromagnetic compatibility (EMC) and the Low Voltage Directive (LVD).

The safety components meet the VDE regulations.

Safety

> **These operating instructions contain important technical and safety information. Please read them carefully before installation and before working on or with the regulator.**

> **The control cabinet must be installed by an authorised specialist, observing local safety regulations.**

> **Access to the environment when connected must be restricted to specialised personnel.**

> **The control cabinet contains live components and must not be opened up.**

> **It must not be used if the housing or connection terminals are damaged.**

> **No fluids must penetrate the housing.**

> **The control cabinet may not be exported to the USA without the manufacturer's express permission.**

Installation
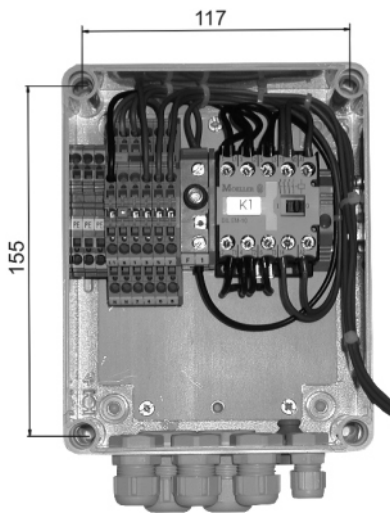
a. Installation of housing

To secure the housing, proceed as follows:

- Drill holes as shown in the diagram, insert rawlplugs if necessary.
- Unfasten the four plastic closure screws and remove the housing top.
- Screw the housing bottom into place.
- Position the electrical wiring and sensor connection in accordance with the following instructions.
- Place the housing top in position and fasten with screws.

b. Fitting the sensor

> **The sensor cable must not be chafed or kinked.**

> **There must be no strong mechanical pressure on the sensor tube.**

> **Do not place the sensor and the high-voltage cable in the same cable conduit (not even within the switchbox).**

Changing the sensor cable length

If it is necessary to shorten or lengthen the sensor cable on installation (or if a sensor other than the one supplied is to be fitted), the "actual value correction" parameter must be adjusted accordingly. See the section "Setting the actual value correction" on page 14.
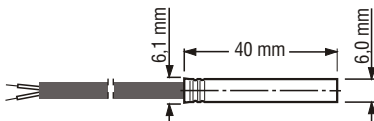
Observe the permitted temperature range to which the sensor is suited:

Sensor cable	temperature range °C
PVC	-30° to + 70 °
Silicon	-50° to +150°

**c.** Elektrical connections

> **The supply voltage may not be switched on until all components, including the sensor, are connected.**

> **Pay attention to the technical data.**

As soon as power is connected to the thermostat, the stirrer will run (for the duration of the programmed afterstirring time C10). The cooling compressor switches on as a function of the milk temperature.

- Electrical connections must be as shown in the diagram below.
- Use cable bushes.
- Make sure that cables cannot chafe.

Housing dimensions and technical data
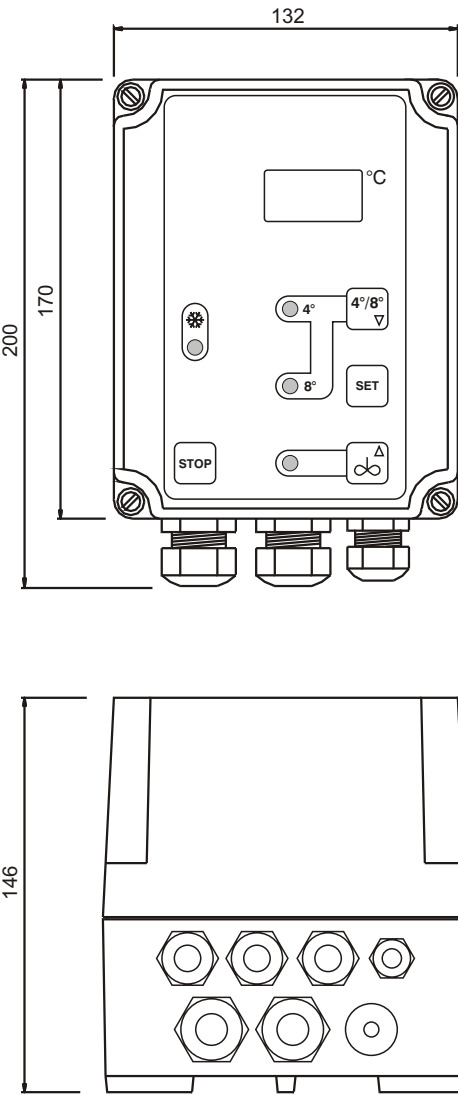
Operating voltage	see version: - 230V AC +N +PE, 50/60 Hz - 400V AC +N +PE, 50/60 Hz

	- 230V AC +N +PE, 50/60 Hz
	   with screw terminals, or when
	   fitted with switching contactor
	 - 400V AC +N +PE, 50/60 Hz
	   with switching contactor and
	   motor protection switch

Relay contacts	2 make-contacts
Max. switching voltage	16A AC 1
Max. switching current	250 V ~
Display	13 mm LED - Display, 3 digits
Display resolution - Range -9,9 .. 99,9° C - other	 0.1° C 1.0° C
Control type	two-step-controller
Measurement range	-50 .. +150°C
Hysteresis	0.1 to 99.9 K free adjustable (standard adjusting 0,7 K)
Type of operation	cooling
Housing	see sketch
Protection	IP 65
Connection	Screw terminals
Environment conditions: - storage temperatur - operation temperatur - max. humidity	 -20 to +70° C 0 to +50° C 75 % (no condensation)

Specifications subject to change without prior notice.

Sensor dimensions and technical data
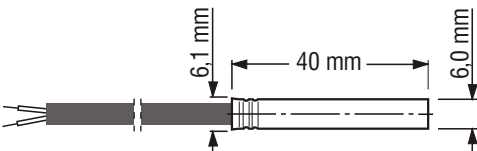
Sensor element	PTC sensor, KTY 10-6
Bush material	1.4301(V2A)
Bush length	40 mm
Bush diameter	6.0 mm +/- 0.1
Cable material	- PVC (standard) - Silicon (special model)
Measurement range - PVC cable - Silicon cable	 -30 .. 70° C -50 .. 150° C
Cable lenght	standard 2 metres
Protection type	IP 65

Operation
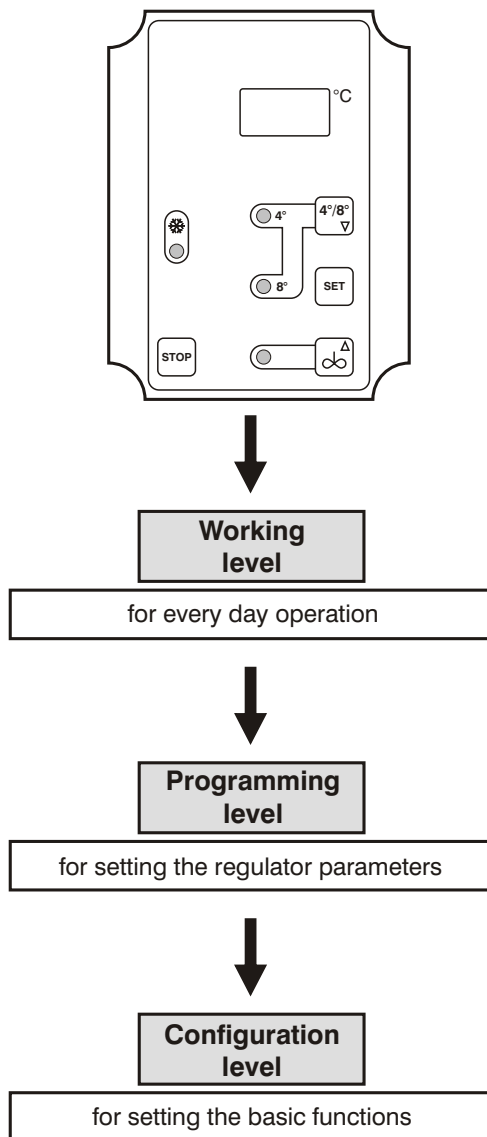
The control cabinet MS-5000 is operated at three levels:

Working level

... for everyday operation by the end user.

When cooling mode is active, the milk temperature as currently measured is permanently displayed.

The working level also contains the functions:

- start cooling mode
- Intermitted stirring during cooling mode (duration depending on pre-setting). See section "Intermediate stirring options during cooling" on Page 13.
- Start permanent stirring
- Switch of
- Switch over target temperatures 4° / 8° (when activ)
- Display and change of target temperatures 4° / 8°Note: The changing of targetTemperatures is only possible, when in programming level the parameter button lock [C99] is set to '0'.

Working level

for every day operation

Programming level

This is the level at which the regulatory parameters are set.

Setting is more complex and possible only using specific combinations of buttons so as to prevent accidental changes to settings.

Programming level

for setting the regulator parameters

Configuration level

This is the level at which the basic functions of the regulator are set.

As subsequent interventions by the end user (after the parameters have been set) can result in dangerous changes to functions which might not be immediately obvious, access to the configuration level is even more complex.

Configuration level

for setting the basic functions

Operation overview
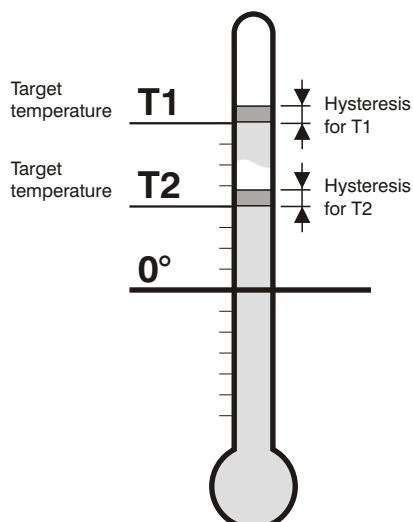
- The milk is cooled to the selected target temperature (4° or 8°). (The adjusted target temperature is displayed by LED 4° or 8°). The stirrer runs constantly at this stage.
- Once the target temperature has been reached the compressor switches off.
- The stirrer switches off after the programmed afterstirring time.
- During refrigeration pauses, the stirrer switches on for the duration of the afterstirring time to ensure an even temperature throughout the milk. This will be repeaded periodically.
- Should the milk temperature exceed the selected target temperature (4° or 8°) by the hysteresis value, the compressor and stirrer are automatically switched on again.

Parameter settings in general
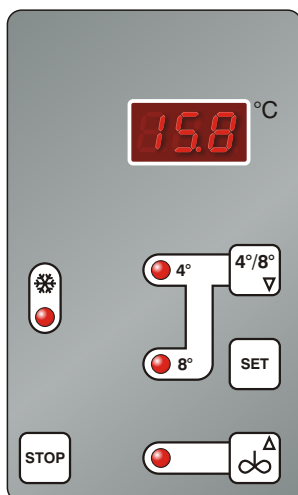
To adjust a parameter, proceed as follows:

- Select parameter.
- Hold button **SET** down during the adjustment operation.
- Use button **Arrow UP** or **Arrow DOWN** to set the required value. NB: Holding buttons longer changes the value more quickly.
- Release button **SET.**

To store the changed parameter in the memory, first release the arrow-button and then button **SET.**

Switching back to working level:

(possible from any parameter)

- Press button **Arrow UP** and **Arrow DOWN** simultaneously for approx. 5 seconds. The current actual value appears in the display. (If, at programming or configuration level, no buttons are pressed for approx. 1 minute, the regulator switches back to working level automatically.)

Working level operation

The working level is for day-to-day milk cooling operation. When the cooling mode is active, the display continuously shows the current milk temperature.
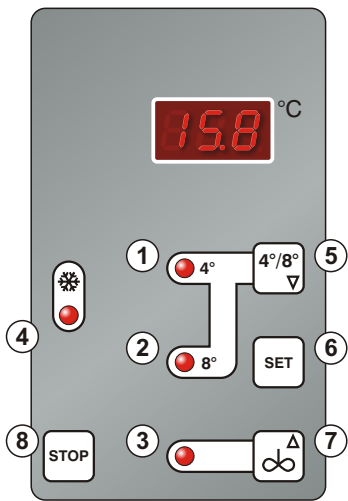
LED	Function
1	LED "4°" shows that target temperature setting for "T1" is active
2	LED "8°" shows that target temperature setting for "T2" is active
3	LED "Agitator" shows if agitator is switched on
4	LED "Compressor" shows if compressor relay is switched on

Operating overview for working level

15.8	present ACTUAL VALUE (displayed continuously)
Switch from target temperature T1 to T2	4°/8° ▽ → ● 4° / ● 8° The LED changes from T1 to T2 or from T2 to T1
SHORT interm. stirring until **Sho** appears	△ ∞ 1 sec. Duration corresponds to programmed value C50
LONG interm. stirring until **Lon** appears	△ ∞ 3 sec. Duration corresponds to programmed value C51

	Display setting	Altering setting	Factory setting
	Press SET button	Press SET and △ or simultaneously ▽	
Target temperature T1 when LED ● 4° lit	SET	⊕ △ ▽ *or*	4°
Target temperature T2 when LED ● 8° lit	SET	⊕ △ ▽ *or*	4°

Changing the target temperature is possible only when the button lock in the programming level [C99] is set to "0".

Button	Function
5	Button "4°/ 8°" (in OFF-mode) = starting of cooling
	Button "4°/ 8°"(in cooling mode) = switch target temperature from T1 to T2, or from T2 to T1 if T2 is active
	Press the "4°/ 8°" button together with button SET (in cooling mode) to adjust the current target temperature downwards
6	Press only SET - button(in cooling mode) = Target temperatur T1 or T2 displayed
	Press SET - button (in cooling mode) together with button 5 or 7 = adjust the current target temperature upwards or downwards
7	Button "Agitator"(in cooling mode) =-press for appr. 1 sec = "SHORT" intermediate stirring -press for appr. 3 sec = "LONG" intermediate stirringSee also the section describing the intermediate stirring options page 13.
	Button "Agitator"(in OFF mode) = continuous stirring
	Press the "Agitator" button together with button SET (in cooling mode) to adjust the current target temperature upwards
8	Button "STOP" = thermostat is in stand-by fuction

Programming level operation
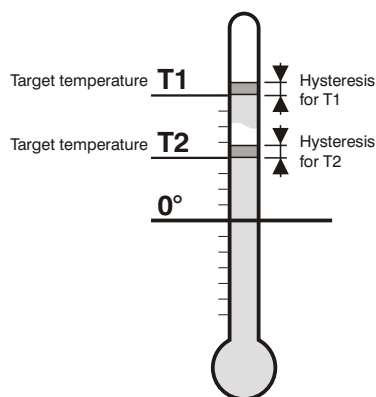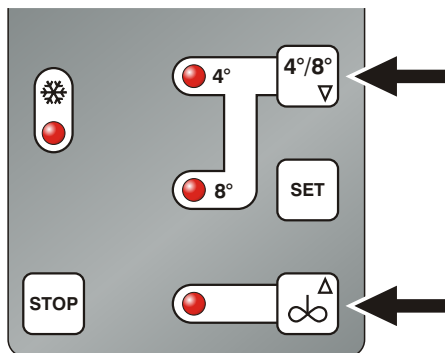
The programming level is for setting the regulatory parameters. Access to this level is more complex in order to avoid accidental resetting of the values by the end user.

Switching to programming level:

- Press button **Arrow UP** and **Arrow DOWN** simultaneously for approx. 5 seconds. The first parameter [C1] appears in the display.
- Press button **Arrow UP** and **Arrow DOWN** until you reach the parameter you want to adjust.

Meaning of parameters

Parameter C1: Target temperature for T1
Parameter C2: Target temperature for T2

The target temperature is the temperature at which the corresponding relay contact is to be activated.

Parameter C10: Hysteresis for target temp. 1
Parameter C11: Hysteresis for target temp. 2

The hysteresis determines how much the milk temperature may deviate from the target temperature before the cooling compressor is switched on. See sketch.

Parameter C20: Duration of afterstirring

Duration (sec.) for which the stirrer runs after the compressor has switched off.

Parameter C21: Duration of pause

Duration (min.) until the stirrer is switched back on after being turned off.

Parameter C50: Duration of SHORT intermittent stirring

Duration (min.) of stirring after short pressing of the "intermittent stirring" button.

Parameter C51: Duration of LONG intermittent stirring

Duration (min.) of stirring after longer pressing of the "intermittent stirring" button.

Parameter C91: Sensor correction

The sensor reading can be provided with a corrector which works cumulatively over the entire measurement range.

See also the section on "sensor installation" Page 14.

Parameter C99: Button lock

Alteration of the target temperatures in the working level can be blocked by setting the button lock.

0 = lock off

1 = lock on.

Operating overview for programming level

To change to programming level =
$\triangle + \triangledown$ *Press for 5 seconds simultaneously, until parameter C1 appears.*

	Display setting Press SET button	Altering setting Press SET and $\triangle$ or simultaneously $\triangledown$	Factory setting
Target temperat. for T1	C1 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	8°
Target temperat. for T2	C2 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	4°
Hysteresis for target temp. 1	C10 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	0,7 K
Hysteresis for target temp. 2	C11 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	0,7 K
Duration of afterstirring	C20 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	120 sec.
Duration of pause	C21 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	20 mins.
Duration of "short" intermittent stirring	C50 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	2 mins.
Duration of "long" intermittent stirring	C51 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	10 mins.
Sensor correction	C91 $\triangle$	SET	➕ $\triangle$ or $\triangledown$	
Button lock	C99	SET	➕ $\triangle$ or $\triangledown$	0

To switch back to the working level:
$\triangle + \triangledown$ *Press for 5 seconds simultaneously (Switches back automatically after 30 seconds.)*

Configuration level operation
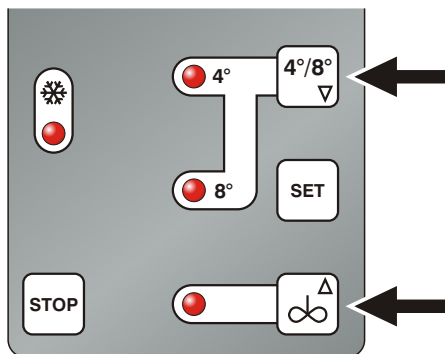
Operation overview for configuration level

Switching to configuration level: see description

		Display setting	Altering setting	Factory setting
		Press button SET	Press button ▽ and △ simultanously	
Sensor failure function K1	P 5 ⚙	SET	➕ △ or ▽	1
Sensor failure function K2	P 6 ⚙	SET	➕ △ or ▽	1
Hysteresis-mode for T1	P 10 ⚙	SET	➕ △ or ▽	1
Hysteresis-mode for T2	P 11 ⚙	SET	➕ △ or ▽	1
Limit for target-temp. T1 downw.	P 20 ⚙	SET	➕ △ or ▽	0
Limit for target-temp. T1 upw.	P 21 ⚙	SET	➕ △ or ▽	10
Limit for target-temp. T2 downw.	P 22 ⚙	SET	➕ △ or ▽	0
Limit for target-temp. T2 upw.	P 23 ⚙	SET	➕ △ or ▽	20
Limit for Hyst. 1 downwards	P 30 ⚙	SET	➕ △ or ▽	0,1
Limit for Hyst. 1 upwards	P 31 ⚙	SET	➕ △ or ▽	2
Limit for Hyst. 2 downwards	P 32 ⚙	SET	➕ △ or ▽	0,1
Limit for Hyst. 2 upwards	P 33 ⚙	SET	➕ △ or ▽	2
Min. action time Compr. K1	P 70 ⚙	SET	➕ △ or ▽	0
Min. pause time Compr. K1	P 71 ⚙	SET	➕ △ or ▽	0
Switching T1 to T2	P 80 ⚙	SET	➕ △ or ▽	0
Mode intermitt. stirring	P 81 ⚙	SET	➕ △ or ▽	1
Temperature scale	P 99	SET	➕ △ or ▽	0

To switch back to the working level:
△ + ▽   *Press for 5 seconds simultaneously (Switches back automatically after 30 seconds.)*

This level is for configuring the regulator's basic functions.

> **To prevent interference by the end user, access is made even more complex.**

Switching to configuration level:
- Press button **Arrow UP** and **Arrow DOWN** simultaneously for approx. 5 seconds.
- The first parameter [C1] appears in the display.
- Press button **Arrow UP** repeatedly until the last parameter [C99] at working level is reached.
- Press button **Arrow UP** again and hold down until [Pb] appears in the display.
- When [Pb] appears, hold down button **Arrow UP** and simultaneously press button **Arrow DOWN** for approx. 3 seconds.
- The display then shows the first parameter [P5] in the configuration level.

Meaning of parameters

Param. P5: Function K1 in event of sensor failure
Param. P6: Function K2 in event of sensor failure

The switching status of the relay contacts can be set for the event of a sensor failure.
0 = OFF in the event of failure
1 = ON in the event of failure
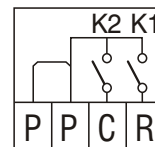
Parameter P10: Hyst. mode for target temperature T1
Parameter P11: Hyst. mode for target temperature T2

(with reference to the compressor relay)

0 = symmetrical
1 = one-sided

The hysteresis determines the value by which the temperature of the medium may deviate from the corresponding target temperature before the relay contact is activated. See diagram.
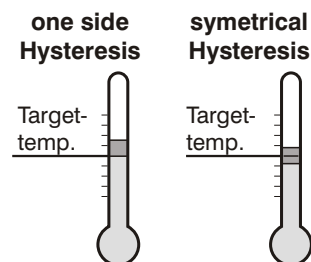
If the contact in question is for cooling, the hysteresis is always upwards. In the case of heating contacts it is below the target temperature (cooling or heating contact is set at configuration level).

In the "symmetrical" hysteresis mode, the value selected is distributed on both sides of the target temperature.

Param. P20: Limit for target temperature T1 downwards
Param. P21: Limit for target temperature T1 upwards
Param. P22: Limit for target temperature T2 downwards
Param. P23: Limit for target temperature T2 upwards

Setting of input limits for target temperatures at working and programming levels.

Range: -10 .. 99°C

Parameter P30: Limit for hysteresis T1 downwards
Parameter P31: Limit for hysteresis T1 upwards
Parameter P32: Limit for hysteresis T2 downwards
Parameter P33: Limit for hysteresis T2 upwards

Setting of input limits for hysteresis at programming level.

Range: 0 .. 99 K

Parameter P70: Minimum action time for compressor K1

Setting of minimum action time for compressor relay contacts K1, in order to prevent repeated switching on and off.

Range: 0.0 .. 999 seconds.

Parameter P71: Minimum pause time for compressor K1

Setting of minimum pause time for compressor relay contacts K1, in order to prevent repeated switching on and off.

Range: 0.0 .. 999 seconds.

Parameter P80: Switch from target temperatur T1 to T2

Setting of funktion: "switching target temperature"

  0 = not possible

  1 = with button

  2 = do not use.

Parameter P81: Function intermittend stirring

Setting of funktion: "start manual intermittend stirring".

See section "Intermediate stirring options during cooling" - page 14.

0 = not possible

1 = Standard (activate intermittend stirring "short" or "long" with button)

2 = do not use.

3 = permanent stirring ON / OFFPress button "Agitator" to start permanent stirring, press button "Agitator" again to stop the stirrer.

Parameter P99: temperature scale
0 = Celsius
1 = not posible

Intermediate stirring options during cooling
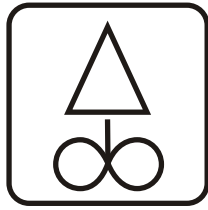
The control cabinet MS-5000 has a function allowing the agitator to be switched on manually. This can be done is different ways.

Regardless of the option chosen, the corresponding LED always indicates when the agitator is operating.

The function is set at configuration level using parameter [P81].

a. Parameter [P81] is set to 1:

"Intermediate stirring SHORT or LONG" can be switched on via the regulator's foil keyboard. In this case:

- Intermediate stirring SHORT =
  Press agitator button for approx. 1 sec. until "Sho" appears in the display. Release the button immediately, otherwise "Intermediate stirring LONG" will be activated.
- Intermediate stirring LONG =
  Press agitator button for approx. 3 secs. until "Lon" appears in the display.

The duration of SHORT or LONG stirring is fixed at settings level using parameters [C50] and [C51].

b. Parameter [P81] is set to 2:

not used.

c. Parameter [P81] is set to 3:

On request the MS-5000 can be set for "continuous stirring", i.e. the agitator can be switched on and off by pressing a button.

When the agitator is switched on or off, the display briefly indicates "ON" or "OFF".

"Continuous stirring" in OFF mode

In OFF mode, "continuous stirring" can be selected by pressing the agitator button, and switched off again by pressing the "STOP" button.

During continuous stirring the agitator LED lights up, and a rotating bar is shown in the display.

Setting the actual value correction

A correction can be made to the value as measured by the sensor, which applies cumulatively over the entire measuring range.

This is necessary when:
- the length of the sensor cable is changed, or
- a faulty sensor is replaced, giving rise to an incorrect reading.

Caution - when changing the sensor:

> **The regulator is adjusted to the selected sensor in the factory. When replacing a faulty sensor, use only the same type.**

In order to adjust the actual value correction, a reference thermometer (e.g. WELBA THM-2000) is needed.

Proceed as follows:
- Install sensor.
- Measure the temperature of the medium using the reference thermometer.
- Switch on the thermostat and set parameter [C91] in the programming level to "0".
- Switch back to working level and read the measured temperature on the display.
- Calculate the difference between the reference thermometer temperature and the display reading.
- Store the difference (pay attention to plus or minus) in the working level under parameter [C91].

Fault indication on the display

Faults in the regulator are indicated by a flashing display as follows:

LED - Display	*Fault*
F1	**Sensor short circuit:** The sensor or sensor cable is faulty and must be replaced or repaired. Parameter [C91] "Actual value correction" must then be adjusted at programming level.
F2	**Broken sensor:** The sensor or sensor cable is faulty and must be replaced or repaired. Parameter [C91] "Actual value correction" must then be adjusted at programming level.
F3	**Memory fault:** Faulty regulator! Remove the regulator and send it for repair.
FFF	**Measurement range exceeded:** The maximum measurement range of the sensor has been exceeded.

General measures when using electronic control systems

So that even complicated regulatory tasks can be presented to the user in a manner which is clear and simple and ensures high measurement accuracy, today's electronic control systems make increasing use of microprocessors. However, the benefits of these systems are countered by the disadvantage that increased measurement accuracy is accompanied by sensitivity to interference. In order to minimise the effect which interference may have on the regulator, the user also must take account of a number of points when installing a new regulator.

Assistance here is provided by standard DIN VDE 0843 on the electromagnetic compatibility (EMC) of measurement, control and regulatory devices in industrial process technology. The following table shows, for example, the maximum interference levels to which, according to the standard, an appliance may be exposed.

Degree of severity	Environment class	Test voltage Power supply	Test voltage Signal/control line
1	well-protected environment	0.5 kV	0.25 kV
2	protected environment	1.0 kV	0.5 kV
3	typical industrial environment	2.0 kV	1.0 kV
4	Industrial environment with very high interference level	4.0 kV	2.0 kV

As the values given in the table are maximum values, operational values should remain well below them. However, in practice this is possible only with difficulty, as even a normal contactor without interference suppression produces interference pulses of up to 3.0 kV. For this reason we recommend that the following principles be taken into account during installation:

a. Try to eliminate all sources of interference, by carrying out interference suppression and minimising the interference level. Radio interference suppression is required under VDE 0875, and confirmed by VDE 0874. In principle, interference must be eliminated at source. The nearer the interference suppresser is to the source of interference, the greater its effect.

Interference spreads through wires or by electromagnetic radiation. It is usually the former which interferes most seriously with regulation systems.

Possible interference sources (to name but a few) include:
- bouncing contacts when switching loads
- switching off inductive loads (contactors, motors, solenoid valves, etc.)
- unsatisfactory routing of wires, too small cross-sections
- loose contacts
- rhythmically changing power stages (power converters)
- power breakers
- high-frequency generators

b. If specific interference sources cannot be avoided, they should at least be kept at a distance from the regulator system.

c. Capacitive and inductive couplings can cause crosstalk between high-voltage lines and parallel low-voltage and sensor lines. This distorts measured values and signals and can disrupt the entire regulatory process. It is therefore recommended that all sensors and signal lines be placed separately from the control and mains voltage lines.

d. If possible, a separate mains line should be provided to feed the regulator system. This helps reduce any interference penetrating the regulator via the mains supply line. Voltage surges resulting from switching substantial loads will also then be less of a problem.

e. In the case of contactors, solenoid valves and other inductive consumers, the induction voltage occurring during switching has to be reduced by appropriate protection methods. The choice of methods depends on whether the consumer runs on DC or AC voltage.
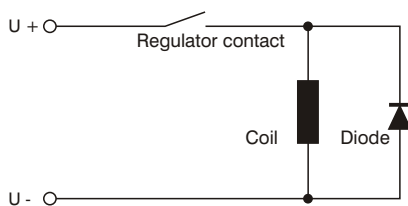

- *DC voltage*
  In the case of d/c voltage systems, the induction voltage occurring can, for example, be limited by using self-induction diodes, varistors or suppresser diodes. The diagram on the left shows one possibility using a self-induction diode.
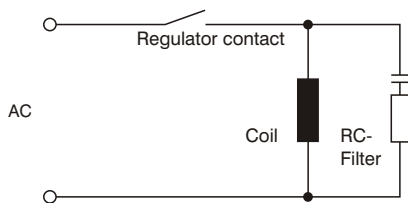
- *AC voltage*
  In the case of a/c voltage, interference suppression as described above is not possible. Instead, an RC combination must be used. An RC filter must be connected as directly as possible to the inductance, in order to ensure a short line. In addition, the component ratings of the RC combination must be geared to the inductance. Too low ratings lead to excessive voltage, and too high ratings cause significant losses in the interference suppresser component. Another point to note here is that only capacitors which meet VDE 0656 may be used. They must be suited to the mains voltage and designed for very high switching voltages. The diagram on the left shows inductance interference suppression using an RC filter.
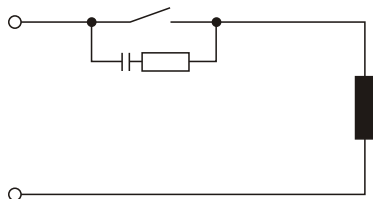
An RC filter should not be fitted directly to the regulator's switching contact, as shown on the left, as an idle current will flow through the RC combination even when the switching contact is open. This current may be enough to mean that a downstream contactor is not de-energised and a closed protective contact does not reopen.

f. Semiconductor switches such as thyristors or triacs also produce interference voltages. They occur as a result of non-linear characteristics and finite ignition voltages. These components must be protected against excessive voltages, for which mainly varistors, RC combinations or choke coils are used. The use of zero-voltage switches is also recommended.

The suggestions made represent only a few of the possible ways of protecting a microprocessor-controlled regulator system from interference. The suggested measures have the advantage that they will increase the lifetime of the devices, as lower induction voltages (reduced spark formation) will also reduce contact burn.